

# Memorandum

To: JOSEPH PRATT - MS #5  
Office of Structure Foundations  
Division of Structures and Foundations

Date: October 17, 2000

File: 11-SD-5 KF 49.33  
EA: 11-0301U1

Los Penasquitos Creek (Widen)  
Bridge No. 57-0511

From: DEPARTMENT OF TRANSPORTATION  
ENGINEERING SERVICE CENTER  
Division of Materials Engineering and Testing Services – MS #5  
Office of Testing and Technology Services

Subject: **Corrosion Review for Los Penasquitos Creek (Widen)**

We have completed our corrosion mitigation review of the Los Penasquitos Creek (Widen) project outlined in a May 8, 2000 memorandum sent to Doug Parks of the Corrosion Technology Branch. Our review is based on corrosion test results of soil samples, summarized information from the Log of test borings, and Caltrans Bridge Design Specifications 8.22 (May 2000 draft).

## Project Description

The site is part of the Route 5/805 Freeway improvements in San Diego County. The proposed bridge will span over Los Penasquitos Creek. The proposed Bents 2 and 3 (to support the proposed widening) will be located within the stream channel.

Plumb 1.2 m (4 ft) diameter Cast-in-Drilled-Hole (CIDH) piles will be used to support the widening at the bridge abutments. Plumb 2.1 m (7 ft) diameter Cast-in-Drilled-Hole (CIDH) piles will be used at the bents for the widening. It is the understanding of the Corrosion Technology Branch that permanent steel casings, 13 mm to 25 mm (1/2 in to 1in) in thickness, will be used as a construction aid on the all CIDH piles. The permanent steel casings will not serve as part of the structural section of the pile. Because, the permanent steel casings will be left in place after construction, they also serve as a barrier against corrosive conditions except at the top of the pile cut-off. The columns will be placed directly on top of the piles with some axial gap remaining between the edge of the steel casing and the bottom of the column. The surface of the gap will be exposed to corrosive soils and/or surface water of Los Penasquitos Creek.

## Corrosion Review

Caltrans defines a corrosive area as an area where the soil and/or water contains more than 500 ppm of chlorides, more than 2000 ppm of sulfates, has a minimum resistivity of less than 1000 ohm-cm, or has a pH of 5.5 or less.

Four soil samples were taken at the Los Penasquitos Creek (Widen) site. Three additional soil samples were taken at the nearby Retaining Wall No. 524 site southeast of the bridge. The soil samples were tested for pH, minimum resistivity, sulfate concentration, and chloride concentration per CTM 417, CTM 422, and CTM 643.

Groundwater was not recently measured at the site. Static groundwater was found at elevation +8.84 m (+29.0 ft) at the nearby Route 5/805 Separation-Widen (Br. 57-0512) on March 2, 2000 (shortly after rains). No samples were taken of the groundwater. However, two samples were taken of the surface water at the Los Penasquitos Channel. The water samples were tested for

pH, minimum resistivity, sulfate concentration, and chloride concentration per CTM 417, CTM 422, and CTM 643. The testing results of the soil and water are listed below.

The pH level of the soil ranged from 7.4 to 8.27. The minimum resistivity of the soil ranged from 475 to 1300 ohm-cm. The sulfate concentration of the soil ranged from 45 ppm to 6000 ppm and the chloride concentration of the soil ranged from less than 25 ppm to 760 ppm.

The pH level of the surface water at Los Penasquitos Channel ranged from 7.4 to 7.6. The minimum resistivity of the surface water at Los Penasquitos Channel was 350 ohm-cm for both samples. The sulfate concentration of the surface water at Los Penasquitos Channel ranged from 361 ppm to 434 ppm, and the chloride concentration of the surface water at Los Penasquitos Channel ranged from 746 ppm to 760 ppm.

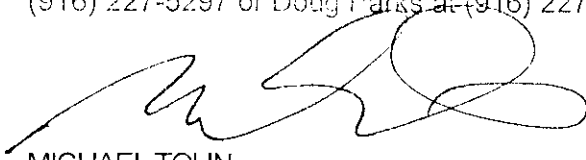
The soil on-site is corrosive based on high levels of sulfates, high levels of chlorides, and low minimum resistivity levels. The surface water on-site is corrosive based on high levels of chlorides and low minimum resistivity levels.

### **Corrosion Recommendations**

In order to maintain a 75-year design life for the structure, we recommend the following corrosion mitigation measures:

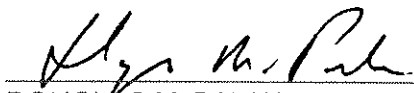
- The minimum concrete cover requirements for chloride environments are addressed in Table 8.22.1 of the BDS (May 2000 draft). Chloride concentrations for soil and surface water at the site are between 500 ppm and 5000 ppm. Consequently, a minimum concrete cover of 75 mm (3 inches) should be used for reinforcing steel in pile caps and/or any other exposed portion of the CIDH piles, walls, footings, and the columns at Bents 2 and 3. For CIDH piles inside a steel shell, the minimum standard concrete cover of 50 mm (2 inches) is required. The steel casings of the CIDH piles will protect the concrete, and steel reinforcement on the inside of the pile from diffusion of chlorides. Also, the permanent steel casing will be seated, or rock socketed, into the bedrock to seal the casing from intrusion of groundwater, and caving of soil. Therefore, the CIDH piles will be protected against chlorides with a permanent full-length steel casing on the sides and the rock socket will protect the CIDH piles at the pile tip.
- The minimum requirements for protection of reinforced and unreinforced concrete against acid and sulfate exposure shall be in accordance with Table 8.22.2 of the BDS (May 2000 draft). For pile caps, and/or any other exposed portion of the CIDH piles, walls, footings, and the columns at Bents 2 and 3 the concrete should contain a minimum cementitious material content of 400 kg per cubic meter. Cementitious material shall consist of 75% by mass Type II modified, or Type V portland cement and 25% by mass mineral admixture conforming to ASTM C618 Type F or N (flyash or natural pozzolans). Also, the water-to-cementitious material ratio shall be a maximum of 0.40.
- For CIDH piles inside a steel casing, no additional concrete corrosion mitigation measures are required. The typical corrosion rate used by Caltrans for steel pipe piles exposed to corrosive soil and/or water in the soil embedded zone is 0.0254 mm/yr (0.001 in/yr) per exposed face. The sacrificial thickness of steel on the CIDH piles would be 1.9 mm (0.075 inches). The minimum thickness of the steel casing for the CIDH piles is 13 mm (0.50 inches) which exceeds the minimum sacrificial thickness previously mentioned. The permanent steel casings will protect the concrete inside the CIDH piles from corrosive conditions during the 75-year design life for the structure.

If you have any questions regarding our comments, please contact Michael Tolin at (916) 227-5297 or Doug Parks at (916) 227-7007.



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Reviewed By:



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